Columbia/Snake Rivers Temperature TMDL
Preliminary Draft July, 2003

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Columbia/Snake Mainstem Temperature Total Maximum Daily Load Executive Summary

1. BACKGROUND

In October 2000, the States of Oregon, Washington and Idaho signed a Memorandum of Understanding with the U.S. Environmental Protection Agency-Region 10 (EPA) that committed EPA to take the lead for technical development of a Columbia/Snake Mainstem Temperature Total Maximum Daily Load (TMDL) and the three states to support of TMDL development. TMDL development is generally a state responsibility, but considering the interstate and international nature of the waters, EPA's technical expertise in the modeling effort, and EPA's Tribal Trust responsibilities, EPA agreed to take responsibility for the technical development of this TMDL. Subsequently, Oregon and Washington requested by letter that EPA issue this TMDL for the Columbia- Snake River Basin within the States of Oregon and Washington. Idaho has committed to simultaneously issue the TMDL for waters within the State of Idaho.

This Columbia/Snake Mainstem Temperature TMDL is necessitated by inclusion of both rivers on the Clean Water Act (CWA) Section 303(d) lists of impaired waters of all three states due to water temperatures that exceed state water quality standards (WQS). EPA and the States, in coordination with the 14 Columbia River Tribal Governments, developed this Draft Columbia/Snake Mainstem Temperature Total Maximum Daily Load Specifically, this draft TMDL was developed under the guidance of a technical steering committee consisting of EPA, the three States and interested Tribes. The Federal Columbia River Power System (FCRPS) Action Agencies (Bureau of Reclamation, U.S. Army Corps of Engineers, and Bonneville Power Administration) all participated in monthly meetings which began in 2001. It is expected that when this draft is released to the public, it will go through a 90 day public comment period. After considering public comments and making changes to the proposed TMDL as appropriate, EPA will issue a Final Columbia/Snake Mainstem Temperature TMDL.

This draft Columbia and Lower Snake Total Maximum Daily Load is one of many other Total Maximum Daily Load (TMDL) efforts currently underway throughout the Region and the Nation, as a tool to improve water quality. The result of this TMDL effort and others is not the establishment of water quality goals. Rather water quality goals for the Columbia and Lower Snake mainstem and other rivers and streams have already been established by state and tribal water quality standards.

2. PURPOSE OF THE DRAFT COLUMBIA/SNAKE MAINSTEM TEMPERATURE TMDL

As required by Section 303(d)(1)(C) of the Clean Water Act (CWA), this draft TMDL has been calculated at a level necessary to implement the applicable water quality standards, which in this case were promulgated by the States of Washington, Oregon, and Idaho, the Spokane Tribe of Indians and EPA (for the Confederated Tribes of the Colville Reservation). The applicable water quality standards are based on the water temperature that would exist in the absence of

human activities in the rivers. The water temperature that would occur in the absence of human activity is not quantified in the standards. Therefore, the specific water temperature targets, the magnitude of temperature problems in the river and the level of temperature improvements in the rivers are not known. Therefore, the purpose of this TMDL is to:

- Define the specific temperature targets in accordance with State and tribal water quality standards;
- quantify the temperature problem in the main stems; and
- determine the level of improvement in water temperature needed to meet water quality standards.

The TMDL analysis uses models in order to calculate water temperature in the absence of human activities. That is, dams and point sources of pollution are mathematically removed from the river. Those model results then become the basis for the loading capacity and allocations presented in the draft TMDL. They are not an endorsement of removal of dam structures; rather, they are necessary to apply the water quality standards.

TMDLs are not self-implementing. Nor do they impose any binding legal requirements under federal law. EPA encourages States to develop plans to implement TMDLs. Except in the case of NPDES-regulated point sources, implementation of TMDLs and the allocations they contain is a question of state law.

3. Background on Temperature Issues in the Columbia and Snake Mainstem

Interest in temperature in the Columbia and Snake River Mainstem peaked during development of the 2000 FCRPS Biological Opinion (2000 FCRPS Bio-Op) by the National Marine Fisheries Service. Many involved in this 2000 FCRPS Bio-Op process believed that elevated temperatures play a significant role and salmon survival and temperature improvements are critical to salmon recovery. Others believe that temperature in the mainstems had not changed significantly from natural conditions.

Ongoing and Future Temperature Improvement Efforts - While the States of Oregon, Idaho and Washington are taking the lead for TMDL implementation planning, they rely heavily on the FCRPS Action Agencies in developing practical steps to be taken to reduce temperature. In fact, development of improvement alternatives requires a system wide evaluation of the FCRPS and the Columbia/Snake River system. Improvements in temperature resulting from operation of the river system will rely heavily on regional, national and even international forums. Because of the complicated policy and technical issues incumbent on implementation planning, in this case, it could be a lengthy process.

The FCRPS has been active in planning and implementing measures to improve water temperature in the Columbia and Snake River main stems. The Bonneville Power Administration is financing sub-basin planning all over the Columbia Basin to improve salmon habitat, including temperature in the tributaries to the Columbia and Snake Rivers. The Corps

of Engineers, through a collaborative approach with fish and water quality managers, has operated Dworshak Dam for the last four years to discharge cooler water to improve temperature in the Lower Snake River. The Bureau of Reclamation has been active in working with EPA in development of the draft TMDL to ensure that there is an adequate understanding of the operation of Grand Coulee Dam and the Columbia Basin Irrigation Project and to brain storm improvement measures that can be evaluated to determine if they are feasible and will have a beneficial effect on water temperature downstream of Grand Coulee while not causing impairment of temperature upstream of the dam in Lake Roosevelt. To date, implementation planning has not included water quality modeling that can be used to evaluate the effects of improvement alternatives at specific dams and sites along the river. In 2002, as part of implementing a 2000 FCRPS Bio-Op Reasonable Prudent Alternative, the FCRPS agencies began an effort to assess monitoring and modeling needs. Working with National Marine Fisheries Service (NOAA Fisheries), Fish and Wildlife Service, EPA, the States and some Tribes, the FCRPS agencies developed an interagency committee that is evaluating monitoring and modeling efforts on the rivers. That committee, chaired by the Corps and NOAA Fisheries, will determine appropriate water quality models and the monitoring necessary to support those models. That committee has been very active and has resulted in intensive monitoring efforts in 2002, including monitoring of temperature in fish passage facilities.

Continued cooperation of the federal agencies, the states and tribes will ensure that the implementation planning results in a balanced strategy that (1) considers ecological needs above and below Grand Coulee, (2) achieves the Congressionally authorized purpose of the FCRPS, and (3) is technically feasible and economically achievable.

3. THE ROLE OF THIS DRAFT TMDL AND THE OVERALL WATER QUALITY IMPROVEMENT PROCESS

The overall process for improving water quality as laid out in the Clean Water Act involves several major steps:

- the desired water quality is defined via state and tribal water quality standards.
- waters of a lower quality than the water quality standards are identified on state and tribal Clean Water Act Section 303(d) lists (also known as “Lists of Impaired Waterbodies”).
- a Total Maximum Daily Load (TMDL) is established for waters on the 303(d) list.
- implementation plans are developed by the state to achieve the TMDL.
- in some cases, a balance must be struck between the TMDL and the water quality standards if the standards cannot feasibly be met under Section 40 CFR 131.10(g).
- the TMDL is implemented through the NPDES Permit Program, State Water Quality Standards Certification Program, States Non-point Source Management Program and other appropriate mechanisms.

During implementation planning , it may become clear that there are no feasible improvement alternatives that will achieve the TMDL. In these cases, the TMDL and the water quality standards may have to be adjusted to achieve the highest levels of water quality that are feasible. Often the TMDL and the implementation plan are developed together and there may even be

iterative revision of the two until a workable mix is achieved. The EPA water quality standards regulations provide for situations where water quality standards cannot be attained. The regulations specifically address dams. At 40 CFR 131.10(g) the regulations say:

> "States may remove a designated use which is not an existing use, as defined in Sec. 131.3, or establish sub-categories of a use if the state can demonstrate that attaining the designated use is not feasible because: ....(4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use."

The regulations also address the concept of economic feasibility at 40 CFR 131.10(g)(6):

> "Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact."

In the case of the draft Columbia and Snake River Mainstem Temperature TMDL, development of the TMDL and implementation planning are now taking place at the same time, though no determination has been made as to whether feasible alternatives exist that will ensure attainment of water quality standards. A Draft Implementation Plan will be available concurrently with this Draft TMDL for public review.

In actuality, implementation can occur simultaneously with the planning processes and in this case a great deal of work is being done to improve temperature in the Columbia and Snakes rivers as previously described. The whole water quality improvement process outlined above, including developing the TMDL, will be an iterative process. As the FCRPS agencies continue to work toward temperature improvements, develop water quality models and collect water quality data, the Final TMDL may updated. The underlying water quality standards may also need to be revised to strike a balance between competing ecological needs and competing uses and values of the river system. If it is not feasible to achieve the Final TMDL without sacrificing ecological needs upstream of Grand Coulee or the other uses of the river system, the water quality standards can be revised. Thereafter, the TMDL can be revised to achieve the new standards.

4. Description of Waterbody, Pollutant of Concern, and Pollutant Sources

This draft Total Maximum Daily Load (TMDL) addresses water temperature in the mainstem segments of the Columbia River from the Canadian Border (River Mile 745) to the Pacific Ocean and the Snake River from its confluence with the Salmon River (River Mile 188) to its confluence with the Columbia River. The States of Oregon and Washington and the U.S. Environmental Protection Agency (EPA) have listed multiple segments of both mainstem reaches on their federal Clean Water Act (CWA) 303(d) lists due to water temperatures that exceed state water quality standards (WQS). The entire reaches of both rivers are considered impaired for water temperature. EPA is establishing this TMDL for waters within the States of Oregon and Washington and within the Reservations of the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians. The Idaho Department of Environmental Quality will simultaneously issue the TMDL for waters within the jurisdiction of the State of Idaho.

Water temperature can be elevated above natural conditions by a number of human activities. The primary sources of elevated temperatures in the Columbia and Snake Rivers are point sources, nonpoint sources, and dams. Point sources discharge thermal energy directly to the river. Nonpoint sources such as agricultural run off discharge to the rivers primarily via irrigation canals and tributaries. Dams alter river temperature by changing the flow regime, stream geometry, current velocity and flood plain interactions of the river.

The effects of point sources and tributaries (nonpoint sources) on cross sectional average water temperatures in the mainstems are for the most part quite small. The point sources can cause temperature plumes in the near-field but they do not result in measurable increases to the cross-sectional average temperature of the main stems. That is, the cumulative impact of all the point sources is less than 0.14 °C when temperature criteria are exceeded in the river. Some of the dams, however, do cause measurable changes in the cross-sectional average temperature of the mainstems. They increase the cross-sectional average temperature and they extend the period of time during which the water temperature exceeds numeric temperature criteria. The impact to water temperature of the dams ranges from very small at Rock Island where the maximum impact is about 0.07 °C to the impact of Grand Coulee which is as high as 6.0 °C in the late fall. Eight of the 15 dams have maximum impacts to temperature of over 0.5 °C.

5. DESCRIPTION OF THE APPLICABLE WATER QUALITY STANDARDS AND NUMERIC TARGETS

The Water Quality Standards (WQS) for temperature on the Columbia and Snake Rivers are quite complex. The three States and two Tribes with EPA-approved or promulgated standards have adopted a variety of numeric and narrative criteria for temperature in the segments of the Columbia/Snake mainstems within their jurisdictions. A common component in all of the standards is a provision to account for times when natural water temperatures in the rivers exceed numeric water quality criteria. Generally, when this occurs, the standards allow small incremental increases to the natural temperatures. Washington WQS, which apply to all of the TMDL project area except the upper 12 miles of the Snake River reach, also restrict incremental increases in temperature when the natural temperature is below numeric criteria. The TMDL is based on the most stringent standards that apply on the rivers reach by reach. Table S-1 summarizes the WQS standards that are the basis for this TMDL.

Table S-1: Summary of Water Quality Standards that Apply to the Columbia and Snake Rivers

Columbia River Reach	Criterion	Natural Temp < Criterion	Natural Temp > Criterion
Canadian Border to Grand Coulee Dam	16 °C DM	Natural + 23/(T+5)	Natural + 0.3 °C
Grand Coulee Dam to Chief Joseph Dam	16 °C DM	Natural + 23/(T+5)	Natural + 0.3 °C
Chief Joseph Dam to Priest Rapids Dam	18 °C DM	Natural + 28/(T+7)	Natural + 0.3 °C
Priest Rapids Dam to Oregon Border	20 °C DM	Natural + 34/(T+9)	Natural + 0.3 °C
Oregon Border to mouth	12.8/20 °C DM	Natural + 1.1 °C	Natural + 0.14°C
Snake River Reach	**Criterion**	**Natural Temp < Criterion**	**Natural Temp > Criterion**
Salmon River to OR/WA Border	12.8/17.8 °C 7DADM	Up to Criterion	Natural + 0.14 °C
OR/WA Border to ID/WA Border	20 °C DM	Natural + 1.1 °C	Natural + 0.3 °C
ID/WA Border to Mouth	20 °C DM	Natural + 34/(T+9)	Natural + 0.3 °C

T = the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge.
DM = daily maximum temperature.
7DADM = seven day average of the daily maximum temperatures.

Development of the target temperatures for the TMDL depends on an understanding of natural temperature. A mathematical water quality model, RBM-10, was used to simulate temperature conditions in the mainstems of the Columbia and Snake Rivers in the absence of human activity in the mainstems. The simulations utilize existing flow and temperature in the tributaries and at the TMDL boundaries. These simulated temperatures are an approximation of natural conditions because they do not account for possible impacts from altered water temperature and flow regimes outside the TMDL project area. To maintain the distinction from purely natural temperatures, these simulated temperatures are referred to as site potential temperatures. This draft TMDL is based on the site potential temperatures; the temperatures that are estimated to occur in the absence of human activity in the mainstems.

The site potential temperatures in the mainstems vary considerably throughout the year, from year to year, and longitudinally along the rivers. To account for the temporal variation, the site potential temperatures are simulated using a thirty year data record and the target temperatures for the TMDL are expressed as thirty year mean temperatures for every day of the year. To account for the spatial variation, the rivers are divided into 21 longitudinal reaches with a TMDL Target Site at the down river end of each reach.

The mathematical model, RBM-10, has been used to evaluate cumulative impacts of upstream temperature impacts on downstream segments of the TMDL. This analysis indicates that elevating temperatures of upstream segments to the degree allowed under the WQS (Table S-1) would result in exceedances of WQS in downstream segments. As a result, the target temperatures in the lower reach of the Columbia River drive the upstream allocations for this TMDL. Therefore, the target temperatures of each reach above the Oregon/Washington Border are lower than those indicated by Table S-1. The targets at each upper reach are lowered enough to ensure that the target temperature in the downstream reach are achieved. Figure S-1 illustrates the existing temperature and the TMDL target temperature at the John Day target site.

6. APPLICATION OF THE TARGET TEMPERATURES

The target temperatures for this TMDL are expressed as daily cross sectional average temperatures. The cross sectional average temperature is representative of the free flowing river because it was generally well mixed. The target temperature must be achieved as a daily cross sectional average in the impounded river but also throughout the width and depth of the thalweg, in critical fish habitat and in fish ladders and holding facilities.

Loading Capacity - The loading capacity is expressed as temperature rather than as thermal load. The regulations governing TMDL development provide for the expression of TMDLs as "either mass per time, toxicity, or other appropriate measure" (40CFR130.2(h)). Temperature is an appropriate measure in this TMDL because dams play a major role in altering the temperature regime of the river but they do not discharge water bearing a thermal load to the river. Dams alter the temperature regime of the river by altering the stream geometry and current velocity upstream of the dam. Expressing the loading capacity and allocations as temperatures addresses a potential concern that flow in the river changes frequently due to river management objectives which can change thermal load without improving temperature. In this TMDL, the loading capacity is the daily target temperature at River Mile 42 of the Columbia River as depicted in Figure 5-1 and in Appendix B.

Pollutant Allocations (see Table S-2) - The underlying philosophy used to establish this TMDL was to allocate available heat capacity to the smallest sources first and then move incrementally up the list of sources from smaller to larger until the available capacity is fully allocated. That is, allocate existing heat load to as many sources as possible. This philosophy arises from the fact that there is insufficient capacity to provide the larger sources any meaningful relief since the total capacity to be allocated is only 0.14 °C most of the year. Therefore, the TMDL first allocates sufficient loads to account for existing discharges from individual NPDES permittees and 20 MW at each target site to account for general NPDES permittees. Any future growth will have to be part of the 20 MW allocated to general permits. The TMDL then allocates remaining capacity to account for as many of the dams as possible beginning with the dams with the smallest effect on temperature.

The analysis of NPDES point sources in the watershed indicates that the cumulative increase of temperature from pointsources to be "de minimus" in comparison to the effects of the dams and

never in and of itself results in exceedance of water quality standards. Even if this TMDL were to allocate the site potential temperature to each point source (ie., a wasteload equal to meeting water quality standards at the end of the discharge pipe), the applicable water quality standards would not be attained in the waterbody because of the temperature increases caused by the dams. In fact, very little benefit would be realized in terms of temperature reductions needed by the dams to achieve water quality standards. At the same time however, EPA recognizes that discharged heat may have local effects even at very small quantities, and as such, should be limited to the extent practicable. Taking these two considerations into account, this TMDL therefore provides a cumulative wasteload allocation applicable to all NPDES facilities in the mainstems that never exceeds 0.14 °C whenever site potential temperature is greater than the water quality criteria. That is, the cumulative effects of all the NPDES point sources is never measurable when the rivers exceed water quality criteria. EPA believes that the wasteload allocations in this TMDL are reasonable in light of the following factors.

- The NPDES point sources, in the aggregate, contribute less than 0.14 °C to the total temperature within each reach when temperature exceeds water quality criteria;
- Limiting the point source discharges to site potential temperatures will have no measurable effect on water quality and reducing them beyond the levels contemplated by the cumulative wasteload allocation is not necessary to achieve water quality standards;
- The majority of the temperature increases (as much as 6 °C) are cause by the larger dams: therefore, water quality standards cannot be achieved under Clean Water Act authorities, therefore water quality improvement must be accomplished through federal, state, private, local and even, conceivably, international mechanisms.

The load available for allocation is the temperature increment over the natural or site potential temperature allowed under the WQS. For example, in the Lower Columbia, this increment is 0.14 °C when numeric criteria are exceeded and 1.1 °C the rest of the time. Some of this temperature increment is consumed by the allocations to the point sources as wasteload allocations (WLA). In the WLA, the load each point source can discharge to the river is expressed as megawatts (MW). There are 108 Point Sources with individual NPDES permits in this TMDL. All but 11 of these point sources have only a minimal effect on mainstem temperatures (defined for the purpose of this TMDL as less than 0.014 °C). These 97 smaller point sources are included in group allocations for each reach. The 11 larger point source dischargers receive individual allocations.

General Permits - EPA, Oregon and Washington have issued 27 general NPDES permits. Currently 16 of them have a total of 96 permittees that discharge to the Columbia or Snake Rivers. The contribution to temperature from the sources covered by the general permits is minimal; especially when compared to the temperature loads from large point sources and the impacts of the dams. An additional 20 megawatts is added to each group allocation to account for these sources.

Tributaries - Since the site potential simulations incorporate existing tributary temperatures, none of the temperature increment is allocated to tributaries. All tributaries are allocated their existing loads.

Dams - The temperature increment remaining to be allocated after allocation to the point sources is very small and therefore, the temperature increase allocated to the 15 dams is also very small. Wells, Rocky Reach, Rock Island, Priest Rapids and The Dalles dams have very small effects on water temperature. They are provided allocations that accounts for the small effects that they currently have. The other dams receive no allocation during the time of the year that water quality criteria are exceeded and a small uniform allocation (0.12 °C) when criteria are not exceeded.

Margin of Safety - Implicit margins of safety have been built into the TMDL. For point sources the WLA is based on reasonable worst case discharges. Further, the wasteload allocation for point sources does not vary with flow. It achieves water quality standards at the 7Q10 **(need to define)** low flow, thereby providing a margin of safety when flows are greater than the 7Q10. For dams, the use of daily average temperatures (as opposed to maximum temperatures only) is a conservative application of the WQS provisions regarding natural temperature conditions.

Seasonal Variation - The water quality standards for temperature, temperature itself and the effects of human activities on temperature all vary seasonally during the year. In the winter and spring, water quality standards are not exceeded, and therefore the waters of the Columbia and Snake rivers are not impaired for temperature from human activities within the main stems. In the late summer and fall, water quality standards are exceeded and the site potential temperatures exceed the water quality criteria, requiring TMDL allocations for temperature that ensure temperature doesn't exceed site potential temperature + 0.14 °C. In the late fall and early winter water quality standards are exceeded but the site potential is less than water quality criteria requiring TMDL allocations that ensure temperatures don't exceed site potential + 1.1 °C. The seasonality of the TMDL is summarized as follows:

February 6 through June 30 - no allocations required;
July 1 through October 31 - allocations to achieve site potential Temperature + 0.14 °C;
November 1 through February 5 - allocations to achieve site potential Temperature + 1.1 °C.

Future Growth - A small portion of the available temperature increases has been allocated to future growth in the group allocations. Twenty MW of heat energy have been added to each group above that needed by the dischargers in the group.

7. MONITORING PLAN - Long term, system wide effectiveness of TMDL implementation activities can be assessed by monitoring mainstem river temperatures at the target sites. Over the long term, if implementation is adequate, the daily mean temperatures at the target site should

equal the 30 year mean target temperatures at those sites. Individual years may exceed those temperatures because of natural variation.

Short term monitoring for compliance with WLAs will be accomplished through effluent monitoring by the point sources. For individual dams, one option for short term monitoring is to evaluate the temperature difference between successive dams. The TMDL includes curves showing the temperature differences for existing conditions and for the conditions of the implemented TMDL. Effectiveness of TMDL implementation within individual impoundments can be determined by comparison of actual temperature differences between dams to the TMDL curves.

8. INFORMATION SHARING AND PUBLIC PARTICIPATION

Extensive public involvement activities, organized by the inter-agency TMDL Coordination Team have occurred for this TMDL over the past three years. Activities included informational meetings throughout the Columbia Basin, information and document access to the Columbia/Snake Mainstem TMDL website, fact sheets, coordination meetings, individual meetings with interested groups, nine public workshops, and numerous conference presentations. The Western Governors' Association also provided public involvement assistance. Public involvement efforts will continue until the TMDL is finalized. Public meetings with the opportunity for formal public comment will be held during the draft TMDL comment period.

9. IMPLEMENTATION PLANS

Implementation of the TMDL is entirely a State responsibility. Pursuant to respective specific state responsibilities, the States of Oregon, Washington, and Idaho have taken the lead for the development of an implementation plan working with interested tribes focused on the identification of feasible management options for improving temperature. States have developed a Summary Implementation Strategy (attached to this Draft TMDL) which identifies short term, mid term and long term implementation actions The short term actions are generally consistent with the temperature Reasonable and Prudent Alternatives (actions to avoid jeopardy under the Endangered Species Act) identified in the December 2000 Federal Columbia River Power System Biological Opinion. The mid-term and long action actions include system-wide actions that could improve water temperature in the long term.

The Summary Implementation Plan has been developed in a collaborative process with the FCRPS Action Agencies. A key element of this Plan is the commitment to evaluate the need to revise water quality standards upon which the TMDL is based should the temperature improvements contemplated by those standards prove to be unattainable.

Implementation is proposed to be coordinated through a TMDL Implementation Workgroup led by the states which retains authorities of participating agencies.

Table S-2: Summary of the Columbia/Snake River TMDL, showing gross allocations for each river reach and individual wasteload or load allocations

River Reach / Facility	Temperature Increase Allowed Within Each Reach		Wasteload Allocation (Temperature Increase and Heat Loads)	Load Allocation (Temperature Increase)	
	July 1 - Oct 31	Nov 1 - Feb 5	July 1 - Feb 5	July 1 - Oct 31	Nov 1 - Feb 5
COLUMBIA RIVER FACILITIES					
International Border to Grand Coulee	**.001 °C**	**0.121 °C**	**0.001 °C**	**0.0 °C**	**0.12 °C**
Group			21.37 MW		
Grand Coulee Dam				0.0 °C	0.12 °C
Grand Coulee to Chief Joseph	**.001 °C**	**0.121 °C**	**0.001 °C**	**0.0 °C**	**0.12 °C**
Group			24.53 MW		
Chief Joseph Dam				0.0 °C	0.12 °C
Chief Joseph to Wells	**.111 °C**	**0.221 °C**	**0.001 °C**	**0.11 °C**	**0.12 °C**
Group			23.78 MW		
Wells Dam				0.11 °C	0.12 °C
Wells to Rocky Reach	**.1315 °C**	**0.0915 °C**	**0.0015 °C**	**0.13 °C**	**0.09 °C**
Group			28.01 MW		
Rocky Reach Dam				0.13 °C	0.09 °C
Rocky Reach to Rock Island	**0.053 °C**	**0.1209 °C**	**0.003 °C**	**0.05 °C**	**0.07 °C**

Group			90.80 MW		
Rock Island Dam				0.05 °C	0.07 °C
River Reach / Facility	**Temperature Increase Allowed Within Each Reach**		**Wasteload Allocation (Temperature Increase and Heat Loads)**	**Load Allocation (Temperature Increase)**	
	July 1 - Oct 31	**Nov 1 - Feb 5**	**July 1 - Feb 5**	**July 1 - Oct 31**	**Nov 1 - Feb 5**
Rock Island to Wanapum	**.001 °C**	**0.121 °C**	**0.001 °C**	**0.0 °C**	**0.12 °C**
Group			20.46 MW		
Wanapum Dam				0.0 °C	0.12 °C
Wanapum to Priest Rapids	**.281 °C**	**0.181 °C**	**0.001 °C**	**0.28 °C**	**0.18 °C**
Group			20.0 MW		
Priest Rapids Dam				0.28 °C	0.18 °C
Priest Rapids to McNary	**.051 °C**	**0.171 °C**	**0.051 °C**	**0.0 °C**	**0.12 °C**
Group			244.13 MW		
Agrium Bowles Road			206.8 MW		
Agrium Game Farm Road			384.5 MW		
Boise Cascade Walulla			284.2 MW		
McNary Dam				0.0 °C	0.12 °C
McNary to John Day	**0.002 °C**	**0.122 °C**	**0.002 °C**	**0.0 °C**	**0.12 °C**

Group			63.18 MW		
John Day Dam				0.0 °C	0.12 °C
John Day to The Dalles	**0.1478 °C**	**0.1108 °C**	**0.0002 °C**	**0.147 °C**	**0.11 °C**
Group			20.73 MW		
The Dalles Dam				0.147 °C	0.11 °C
River Reach / Facility	**Temperature Increase Allowed Within Each Reach**		**Wasteload Allocation (Temperature Increase and Heat Loads)**	**Load Allocation (Temperature Increase)**	
	July 1 - Oct 31	**Nov 1 - Feb 5**	**July 1 - Feb 5**	**July 1 - Oct 31**	**Nov 1 - Feb 5**
The Dalles to Bonneville	**.004 °C**	**0.124 °C**	**0.004 °C**	**0.0 °C**	**0.12 °C**
Group			99.07 MW		
Bonneville Dam				0.0 °C	0.12 °C
Bonneville to River Mile 112	**.02 °C**	**0.02 °C**	**.02°C**	**0.0 °C**	**0.0 °C**
Group			164.04 MW		
Fort James Camas			337.8 MW		
River Mile 112 to River Mile 95	**0.026 °C**	**0.026 °C**	**.026 °C**	**0.0 °C**	**0.0 °C**
Group			926.3 MW		
River Mile 95 to River Mile 72	**0.045 °C**	**0.045 °C**	**0.045 °C**	**0.0 °C**	**0.0 °C**
Group			42.84 MW		

Boise/ St.Helens			219.56 MW		
Coastal St. Helens			365.09 MW		
River Reach / Facility	**Temperature Increase Allowed Within Each Reach**		**Wasteload Allocation (Temperature Increase and Heat Loads)**	**Load Allocation (Temperature Increase)**	
	July 1 - Oct 31	**Nov 1 - Feb 5**	**July 1 - Feb 5**	**July 1 - Oct 31**	**Nov 1 - Feb 5**
River Mile 72 to River Mile 42	**0.056 °C**	**0.56 °C**	**0.056 °C**	**0.0 °C**	**0.0 °C**
Group			235.85 MW		
Longview Fiber			455.4 MW		
Weyerhouser Longview			545.43 MW		
GP Wauna			301.71 MW		
River Mile 42 to River Mile 4	**0.001 °C**	**0.001 °C**	**0.001 °C**	**0.0 °C**	**0.0 °C**
Group			46.79		
River Mile 4 to River Mile 0	**0.001 °C**	**0.001 °C**	**0.001 °C**	**0.0 °C**	0.0 °C
Group			26.28		
River Reach / Facility	**Temperature Increase Allowed Within Each Reach**		**Wasteload Allocation (Temperature Increase and Heat Loads)**	**Load Allocation (Temperature Increase)**	
	July 1 - Oct 31	**Nov 1 - Feb 5**	**July 1 - Feb 5**	**July 1 - Oct 31**	**Nov 1 - Feb 5**
SNAKE RIVER FACILITIES					
Salmon River to River Mile 138					

	0.06 °C	**0.06 °C**	**0.06 °C**	**0.0 °C**	**0.0 °C**
Group			**30.28 MW**		
Potlatch			298.76 MW		
River Mile 138 to Lower Granite	**0.003 °C**	**0.123 °C**	**0.003 °C**	**0.0 °C**	**0.12 °C**
Group			20.0 MW		
Lower Granite Dam				0.0 °C	0.12 °C
Lower Granite to Little Goose	**0.003 °C**	**0.123 °C**	**0.003 °C**	**0.0 °C**	**0.12 °C**
Group			20.02 MW		
Little Goose Dam				0.0 °C	0.12 °C
Little Goose to Lower Monumental	**0.003 °C**	**0.123 °C**	**0.003 °C**	**0.0 °C**	**0.12 °C**
Group			21.39 MW		
Lower Monumental Dam				0.0 °C	0.12 °C
Lower Monumental to Ice Harbor	**0.003 °C**	**0.123 °C**	**0.003 °C**	**0.0 °C**	**0.12 °C**
Group			20.004 MW		
Ice Harbor Dam				0.0 °C	0.12 °C
Ice Harbor to River Mile 0	**0.003 °C**	**0.003 °C**	**0.003 °C**	**0.0 °C**	**0.0 °C**
Group			20.004 MW		

1.0 Introduction

1.1 The Role of this TMDL and the Overall Water Quality Improvement Process

The overall process for improving water quality as laid out in the Clean Water Act involves several steps. First, the desired water quality is defined via state water quality standards. Second, waters of a lower quality than the water quality standards are identified on state 303(d) lists (also known as "Lists of Impaired Waterbodies"). Third, a Total Maximum Daily Load (TMDL) is established for waters on the 303(d) list. Fourth, implementation plans are developed by the state to achieve the TMDL. Fifth, in some cases, a balance must be struck between the TMDL and the water quality standards. During implementation planning, it may become clear that there are no feasible improvement alternatives that will achieve the TMDL. In these cases, the TMDL and the water quality standards may have to be adjusted to achieve the highest levels of water quality that are feasible. Finally, the TMDL is implemented through the NPDES Permit Program, State Water Quality Standards Certification Program, the States Non-point Source Management Program and other appropriate mechanisms.

Often the TMDL and the implementation plan are developed together and there may even be iterative manipulation of the two until a workable mix is achieved. In the case of the main stems temperature TMDL, the two have been kept some what separated. Interest in temperature in the main stems peaked during development of the 2000 Federal Columbia River Power System (FCRPS) Biological Opinion by the National Marine Fisheries Service (NMFS) and the Fish and Wildlife Service (FWS). Many believed that elevated temperatures played a role in the reduction of salmon runs, while others believed that temperature in the main stems had not changed significantly from natural conditions. Further, the water quality standards do not establish a clear target for temperature and require considerable analysis. So it wasn't clear if there was a temperature problem, how severe it was or what was causing it. Implementation planning to improve water temperature could be very costly, especially for the federal and public utility district dams on the rivers. Therefore, it is prudent to verify that a problem exists and to quantify the extent of the problem before investing a great deal. Essentially, the role of this TMDL in improving temperature in the Columbia/Snake River main stems is to clarify these issues. The purpose of this TMDL is to:

1. define the temperature targets;
   quantify the temperature problem on the main stems;
   determine the level of improvement needed.

The TMDL, therefore, uses water quality modeling to determine the specific water temperature targets for the main stems on the basis of state water quality standards. The water quality standards require identification of what the temperatures would be in the absence of human activities on the main stems. Having determined the temperature regime required by the state water quality standards, the TMDL evaluates whether the existing main stems achieve those target temperature regimes and quantifies the contributions of existing human activities to temperature increases in the river. This TMDL finds that temperature does exceed the target temperature regimes required by state water quality standards so it goes on to quantify the improvement needed and allocate heat loads to the various human activities on the main stems that, if achieved, will result in compliance with the target temperatures.

The next step in improving temperature in the main stems is to develop the implementation plan. That is, determine what specific operational changes at the dams and point sources of heat along the rivers can be implemented to achieve the TMDL and ultimately achieve water quality standards. In other words, what feasible alternatives are available to improve temperature. The TMDL identifies some of the dams on the main stems to be the major contributors to temperature increases in the main stems. Implementation planning to achieve temperature improvements at dams will be technically complicated, costly and generally outside Clean Water Act authorities. The federal dams were specifically authorized by Congress for specific purposes such as flood control, power generation, irrigation and navigation. Decisions on the feasibility of alternatives to improve temperature at these facilities will have to consider the ability of the FCRPS to continue achieving the purposes established by Congress, the technical feasibility of the alternatives and the economic feasibility of the alternatives.

The states take the lead for TMDL implementation planning but they will rely heavily on the Federal Agencies that administer and operate the FCRPS. In fact, development of improvement alternatives will require a sytstem wide evaluation of the FCRPS and the Columbia/Snake River system. Improvements in temperature resulting from operation of the river system will rely heavily on regional, national and even international forums. Because of the complicated policy and technical issues incumbent on implementation planning, in this case, it could be a lengthy process.

However, that is not to say that the FCRPS has been inactive in planning and implementing measures to improve water temperature in the Columbia and Snake River main stems. The Bonneville Power Administration is financing sub-basin planning all over the Columbia Basin to improve salmon habitat, including temperature in the tributaries to the Columbia and Snake Rivers. The Corps of Engineers has operated Dworshak Dam for the last three years to discharge cooler water to improve temperature in the lower Snake River. Every year, the Corps works with EPA, NMFS and the states and tribes to refine and fine tune it's approach to operating the Dworshak Dam. Two major limitations on implementation planning have been the lack of data to adequately characterize water temperature and the lack of water quality modeling that can evaluate the effects of improvement alternatives at specific dams and site along the river. In 2002, the FCRPS agencies began an effort to address these limitations.

Working with NMFS, FWS, EPA, the states and the tribes, the FCRPS agencies developed an interagency committee that is evaluating monitoring and modeling efforts on the rivers. That committee, chaired by the Corps and NMFS, will determine appropriate water quality models and the monitoring necessary to support those models. That committee has been very active and has resulted in intensive monitoring efforts in 2002, including monitoring of temperature in fish passage facilities. The Bureau of Reclamation has been active in working with EPA in development of the TMDL to ensure that there is an adequate understanding of the operation of Grand Coulee Dam and the Columbia Basin Irrigation Project and to brain storm improvement measures that can be evaluated to determine if they are feasible and will have a beneficial effect on water temperature downstream of Grand Coulee while not causing impairment of temperature upstream of the dam in Lake Roosevelt.

Continued cooperation of the federal agencies, the states and tribes will ensure that the implementation planning results in a balanced strategy that considers ecological needs above and below Grand Coulee and achievement of the Congressionally authorized purpose of the FCRPS and is technically feasible and economically achievable. Step 5 of the water quality improvement process is to alter the TMDL and the water quality standards, as appropriate, to strike this balance between competing ecological needs and competing uses and values of the river system. If it is not feasible to achieve the TMDL without sacrificing ecological needs upstream of Grand Coulee or the other uses of the river system, the water quality standards can be amended and the TMDL revised to achieve the new standards.

The EPA water quality standards regulations provide for situations where water quality standards cannot be attained. The regulations specifically address dams. At 40 CFR 131.10(g) the regulations say "States may remove a designated use which is not an existing use, as defined in Sec. 131.3, or establish sub-categories of a use if the state can demonstrate that attaining the designated use is not feasible because: ....(4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use." The regulations also address te concept of economic feasibility at 40 CFR 131.10(g)(6): "Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact."

Sequentially, the final step in the improvement process is actual implementation of the measures to improve water quality. In actuality, implementation can occur simultaneously with the planning processes and in this case a great deal of work is being done to improve temperature in the Columbia and Snakes rivers as described above. The whole water quality improvement process outlined above, including the TMDL will be an iterative process. As the FCRPS agencies continue to work toward temperature improvements, develop water quality models and collect water quality data, the TMDL may updated.

1.2 Scope of this TMDL

The scope of this TMDL is water temperature in the main stem segments of the Columbia River from the Canadian Border (River Mile 745) to the Pacific Ocean and the Snake River from its confluence with the Salmon River (River Mile 188) to its confluence with the Columbia River (see Figure 1-1). Table 1-1 summarizes the portions of the two rivers listed as impaired for temperature pursuant to Section 303(d) of the Clean Water Act. EPA listed the Snake River from the Salmon River to the Washington/Idaho Border on the Idaho 1998 Section 303(d) list (EPA, 2001). Oregon included the entire Oregon portions of the Snake and Columbia rivers on its 1998 Section 303(d) list (Oregon DEQ, 1998). Washington included 26 different segments of the two rivers on its 1998 Section 303 list (Washington DOE, 1998). In a letter dated September 4, 2001, Washington clarified that "...much or all of the mainstem Columbia and Snake Rivers violate water quality standards for temperature..." and that the entire lengths of the Columbia and Snake rivers should be addressed in the temperature TMDL (Washington DOE, 2001). This TMDL addresses dams, point sources and non-point sources of thermal loading to the main stems themselves. There are 15 dams, as well as 108 point sources regulated by individual National Pollutant Discharge Elimination System (NPDES) permits, on the two main stems addressed by this TMDL. There are also 27 general NPDES permits that currently regulate 96 facilities on the Snake and Columbia rivers. The thermal loadings from non-point sources enter the main stems primarily through tributaries and irrigation return flows. There are 193 tributaries including seven significant irrigation flows addressed in this TMDL.

1.3 Legal Authority

Under authority of the Clean Water Act, 33 U.S.C. § 1251 et seq., as amended by the Water Quality Act of 1987, P.L. 100-4, the U.S. Environmental Protection Agency is establishing a Total Maximum Daily Load (TMDL) for temperature in the main stems of the Columbia River from the Canadian Border to the Pacific Ocean and the Snake River from its confluence with the Salmon River to its confluence with the Columbia River. EPA is establishing the TMDL for waters within the states of Washington and Oregon and waters within the reservations of the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians. At this time, the Idaho Department of Environmental Quality is anticipating simultaneously issuing the TMDL for waters within the jurisdiction of the State of Idaho.

The States of Oregon, Washington and Idaho worked with EPA in coordination with the thirteen tribes of the Columbia Basin to develop this inter-jurisdictional TMDL for the Columbia and Snake River main stems. The Oregon Department of Environmental Quality requested in writing (Oregon DEQ, 2001) that EPA establish the TMDL in the State of Oregon. The Department cited the interstate nature of the waterway, EPA's development of the temperature model, RBM 10, and the Department's lack of resources as the reasons for its request. The request was made pursuant to Section X of the TMDL Memorandum of Agreement between EPA and the Department of Environmental Quality dated February 1, 2000.